APPARATUS FOR MOVING THROUGH A PIPE

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APPARATUS FOR MOVING THROUGH A PIPE

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This invention relates to an apparatus moved through a pipe by a stepping cable and more particularly to improvements in the invention of my co-pending application, Serial No. 610,186, filed September 17, 1956 for Apparatus for Moving a Line Through Conduit.

It is sometimes desirable to move apparatus of this type through a pipe that is delivering gas under pressure. In such instances the crawler must frequently be inserted and retrieved from the line through side door lubricators. I have found that it is possible to build such an apparatus around a spring which permits the apparatus to bend along substantially its entire length and be easily inserted and removed from a line through a side door lubricator.

I have also found that by rearranging the component parts of the moose of my previous invention, the tendency of the body of the apparatus to bend or buckle can be reduced or eliminated. Another object is to provide an apparatus that will facilitate the removal of the stepping cable from the pipe.

An apparatus of this type is constructed to move in only one direction through a pipe. Thus, if it is moved by the stepping cable past the retrieving lubricator, it cannot be backed up and retrieved through this lubricator. By this invention there is provided a new means for removing apparatus of this type from a line through a side door lubricator which connects with the apparatus before it reaches the retrieving lubricator and signals the approach of the apparatus to the lubricator.

It is an object of this invention to provide a stepping cable operated apparatus for moving through a pipe in which substantially the entire body of the apparatus is bendable to permit the apparatus to easily negotiate side door lubricators and pipe bends.

Another object is to provide a stepping cable operated apparatus for moving through a pipe in which the body of the apparatus is provided by a spring to permit bending of the body.

Another object is to provide a stepping cable operated apparatus in which the component parts are arranged to minimize the tendency of the body of the bending operation to bend with operation of the stepping cable means.

Another object is to provide a stepping cable operated apparatus in which the side actuated by the stepping cable travels a path as close as possible to the collapsible fingers fixedly carried by the body for engaging the pipe to minimize the bend of the body to bend with operation of the stepping cable.

Another object is to provide a stepping cable operated apparatus in which the resilient means, which causes movement of the apparatus upon slackening of the stepping cable means, is a tension member located behind the slide to minimize the tendency of the body to bend with operation of the stepping cable.

Another object is to provide a stepping cable operated apparatus which will move through pipe of a wide range of sizes.

Another object is to provide apparatus for easily coupling together a catching rod inserted into a line through a side door lubricator and a stepping cable operated apparatus to facilitate removal of the cable operated apparatus from a pipe line.

Another object is to provide a stepping cable operated apparatus which automatically couples onto a catching rod as it approaches a side door lubricator.

Another object is to provide catching means for a stepping cable operated apparatus which will signal the approach of the apparatus to a retrieving lubricator and thus insure that the apparatus is not moved past the retrieving lubricator by the stepping cable.

Other objects, features and advantages of this invention will be apparent from the drawings, the specification and the claims.

In the drawings wherein there is shown an illustrative embodiment of this invention and wherein like reference numerals indicate like parts:

FIGURE 1 is a vertical section through a pipe line illustrating a stepping cable operated apparatus being introduced into the line through a side door lubricator and the catching rod in position in the retrieving lubricator where it will be engaged by the apparatus as it moves through the pipe;

FIGURES 2A and 2B are continuation views on an enlarged scale in longitudinal cross section illustrating the stepping cable operated apparatus shown in FIGURE 1;

FIGURES 3 and 4 are similar elevational views illustrating operation of the apparatus with FIGURE 3 illustrating the stepping cable moving the slide forward and with FIGURE 4 illustrating the movement of the body of the apparatus forward relative to the slide with releasing the stepping cable;

FIGURE 5 is a view taken along the lines 5—5 of FIGURE 3;

FIGURE 6 is a perspective view of the head of the stepping cable operated apparatus and the catching rod in their position of initial engagement;

FIGURE 7 is a perspective view similar to FIGURE 6 in which the stepping cable operated apparatus and rod have been connected together and further advance of the apparatus will cause movement of the rod out of the lubricator to signal the approach of the stepping cable operated apparatus; and

FIGURE 8 is a view similar to FIGURES 6 and 7 showing the retrieving rod pulling the stepping cable operated apparatus after it as it is withdrawn through a retrieving lubricator.

Referring first to FIGURE 1, a gas line for delivering gas is indicated generally at 10. There is a conventional tap 11 made on the line at a 45 degree angle. A gate valve indicated generally at 13 is flanged to the conventional tap 11. A launching tube or side door lubricator 12 is secured to the open end of the gate valve which is attached to the pipe line at 11. A packing gland 14 is provided at the free end of the lubricator.

The packing gland permits the passage of a launching rod 15 and a stepping cable 16 while maintaining the launching tube fluid tight.

The apparatus is placed within the launching tube and the packing gland 14 is replaced. The gate valve 13 is then opened and the apparatus moved into the pipe line with the launching rod. As will be seen from FIGURE 1, the body of the apparatus is free to bend as it moves into the pipe, thus permitting it to be launched from a side door lubricator.

Referring particularly to FIGURES 2A and 2B, it will be noted that the body 17 of the apparatus is provided by spring means which permits bending or turning of the body in the lubricator as shown in FIGURE 1 and permits the body to negotiate bends in the line. While any form of spring body, such as a leaf spring or coil spring, might be employed, it is preferred to use
a coil spring as illustrated, in which the convolution of the coil are engaged with each other when the coil spring is in an unstressed condition. This makes the body 17 substantially incompressible in a longitudinal sense while permitting it to bend laterally to negotiate turns.

As the convolutions of a coil spring are essentially thread-like in nature, the several components of the apparatus which are desired to be rigidly attached to the body may be provided with male threaded sections such as at 18 of FIGURE 2A which will threadedly engage the spring.

A slide is customary with devices of this sort, a means is provided for engaging the pipe and permitting the body to move in only one direction. This means is shown at the nose of the apparatus at 19 and is fixedly carried on the body of the apparatus. The pipe engaging means 19 includes a plurality of arms 21 which engage the pipe and permit it to move in the forward direction only. These arms are resiliently loaded toward their extended position by tension springs 22 and are collapsible to permit their ready passage through the lubricator. A bell housing 23 is provided to prevent the mechanism from catching the pipe.

A slide indicated generally at 24 is mounted for reciprocation along spring 17. This slide also includes a plurality of arms 25 which are collapsible and are urged into pipe engaging position by a plurality of tension springs 26. The slide 24 is free to move through the pipe in the forward direction of movement of the body 17, that is in a forward direction.

By reference to FIGURE 5 it will be noted that arms 21, 27 and 28 are of a common length and that arms 29, 30 and 31 are of a common slightly greater length. The several arms of slide 24 are constructed in like manner. Only one group of arms effectively engages a pipe of a given range and the other group of arms engages a pipe of a slightly different given range. This feature permits a single apparatus to be used in pipe of a relatively wide range of diameters.

Means are provided for reciprocating the slide 24 relative to body 17 to move the apparatus through a pipe line. Preferably this means includes a resilient means such as a spring 32 and a stepping cable means provided by cable 16 and the pulley indicated generally at 33.

One of the features of this invention is the arrangement of the resilient means 32 in such a position that the collapsible means 19 and the collapsible slide 24 for engaging the pipe may be located as closely as possible to each other. By arranging the two means 19 and 24 as closely to each other as possible, the tendency of the body to bend or buckle while the stepping cable is moving the slide 24 forward is minimized. In other words, the body 17 is in effect a column under compression when the stepping cable is pulled and by reducing the effective length of the column, the tendency of the column to buckle under compression is decreased. Thus it will be appreciated that by locating the resilient means 32 on the side of the slide remote from the fixed collapsible means, the tendency of the body to bend is reduced. This arrangement also permits the spring 32 to be placed in tension by pulling on the stepping cable, which is preferred.

The spring 32 is fastened to the slide 24 and to the tailpiece 34 of the body by threading the opposite ends of the spring through slots 35a and 36a in flanges 35 and 36, respectively (FIGURE 3).

Referring again to the stepping cable means, the pulley 33 is protected against hanging up in the pipe by a guard 37 carried by a sleeve 38 which is fixed on the body by stud 39. After the stepping cable 16 passes through the body from the rear thereof to the pulley 33, its direction is reversed by the pulley 33 and it is secured to the slide 24 as indicated at 40 (FIGURE 2B).

In order to retrieve the apparatus from a line, a retrieving lubricator 41 is provided. The retrieving lubricator is identical in construction with the rod lubricator 12 and will be located several hundred feet down line 10. If the apparatus is moved past the retrieving lubricator by the stepping cable, it cannot be removed through this lubricator as the direction of the apparatus through the pipe cannot be reversed. Therefore, it is desirable to provide means for catching the apparatus apparatus from the retrieving lubricator and to signal that the apparatus is approaching the retrieving lubricator so that operation of the stepping cable will not be continued.

Such an apparatus is provided by the retrieving rod 42 which may be extended into the pipe line and carry a connecting means which, when engaged by a connecting means on the nose of the apparatus, will connect the apparatus and retrieving rod together.

Preferably the connecting means on the apparatus is provided by an enlargement 43 on a flexible means such as chain 44 carried on the nose of the apparatus. The connecting means on the retrieving rod is provided by a slotted member indicated generally at 45. The length of the flexible member 44 should be such as to permit the enlargement 43 to rest on the bottom of the pipe. The catching means 45 includes a V-shaped notch 46 in which the enlargement 43 will hang and connect the rod to the apparatus. Preferably the catching means 45 includes a plate 47 on its upper side which has the V-shaped notch 46 formed therein with its apex at the nose of the rod 42. Of course the member 45 has an open interior to permit the enlargement 43 to pass through. To signal the engagement of the apparatus with the retrieving rod, it is provided to permit a second notch 48 opposing the notch 46 which will catch the enlargement 43 and prevent forward movement of the apparatus relative to the catching rod. This will cause movement of the catching rod out of the lubricator 41 and signal the approach of the apparatus to the retrieving lubricator.

These notches 46 and 48 are positioned opposite to each other and form a double V notch as shown in each of FIGURES 6 through 8.

In operation the valve 13 of lubricator 12 is first closed and the packing 14 removed. The apparatus may then be inserted in the lubricator and the packing gland 14 replaced. Thereafter, valve 13 is opened and the apparatus is pushed into the pipe 10 with the launching rod. As shown in FIGURE 1, the body 17 will bend to permit the insertion such a position that it is in the pipe. After the apparatus is located in the pipe, the stepping cable 16 is pulled to advance the slide 24 along body 17. At this time the legs of the collapsible means 19 will engage the pipe and prevent rearward movement of the apparatus. After the spring 32 has been stretched, the stepping cable is relaxed and spring 32 permitted to contract. At this time the collapsible legs of slide 24 will engage the walls of pipe and prevent backward movement of the slide.

Therefore, upon contraction of spring 32, the body 17 will move forward in the pipe. Due to the positioning of the two collapsible means for engaging the pipe closely adjacent to each other, the tendency of the spring body to bend will be minimized.

Before the apparatus approaches the retrieving lubricator 41, the retrieving rod is run into the line and extended some distance along the line toward the launching lubricator 12. As the apparatus comes in contact with another 45, the enlargement 43 will be directed to the center of plate 45 due to its slightly annular shape. Note FIGURES 7 and 8 in which the plate 47 is shown to be circular in a longitudinal direction. As the enlargement 43 passes over the top of the plate, it drops into the double V notch and engages V 48. Continued operation of the stepping cable will cause the retrieving rod 42 to begin to move out of lubricator 41 and signal the engagement of the apparatus by the rod.

At this time, operation of the stepping cable should cease and by pulling the rod 42 out of the lubricator, the enlargement will be caught in the V notch 46 and
will pull the apparatus into the retrieving lubricator 41 from whence it may be removed from the pipe line.

The foregoing disclosures and descriptions of the invention are illustrative and explanatory thereof, and various changes in the size, shape and materials, as well as in the details of the illustrated construction may be made within the scope of the appended claims without departing from the spirit of the invention.

What is claimed is:

1. Apparatus for moving through a pipe comprising, an elongate flexible spring, collapsible means fixed on the spring for engaging a pipe and preventing movement of the apparatus in one direction, a slide mounted for relative movement along the spring and having collapsible means for engaging a pipe and preventing movement of the slide through a pipe in said one direction, resilient means on the side of the slide remote from the fixed collapsible means urging the slide along the spring, and stepping cable means for alternately moving the slide against the resilient means and permitting the resilient means to move the slide relative to the spring.

2. Apparatus for moving through a pipe comprising, an elongate coil spring having its convolutions in engagement with each other, collapsible means fixed on the spring for engaging a pipe and preventing movement of the apparatus in one direction, a slide mounted for relative movement along the spring and having collapsible means for engaging a pipe and preventing movement of the slide through a pipe in said one direction, a second coil spring attached to one end of and concentric with the elongate spring, said second coil spring positioned on the side of the slide remote from the fixed collapsible means and urging the slide along the elongate spring, and stepping cable means for alternately moving the slide against the second spring to place it in tension and permitting the second spring to move the slide and the elongate spring relative to each other.

3. Apparatus for moving through a pipe comprising, an elongate flexible body, first and second sets of collapsible fingers of different length fixed on the body for engaging pipe of different sizes and preventing movement of the apparatus in one direction, a slide mounted for relative movement along the body and having first and second sets of collapsible fingers of different length for engaging pipe of different size and preventing movement of the slide through a pipe in said one direction, resilient means urging the slide along the body, and stepping cable means for alternately moving the slide against the resilient means and permitting the resilient means to move the slide and body relative to each other.

4. Apparatus for moving through a pipe comprising, an elongate flexible body, a collapsible means fixed on the body for engaging a pipe and preventing movement of the apparatus in one direction, a slide mounted for relative movement along the body and having collapsible means for engaging a pipe and preventing movement of the slide through a pipe in said one direction, resilient means on the side of the slide remote from the fixed collapsible means urging the slide along the body, and stepping cable means for alternately moving the slide against the resilient means and permitting the resilient means to move the slide and body relative to each other.

5. The apparatus of claim 4 wherein the resilient means is a tension spring.

6. Apparatus for moving through a pipe comprising, a first elongate coil spring having its convolutions in engagement with each other, collapsible means fixed on the spring for engaging a pipe and preventing movement of the apparatus in one direction, a slide mounted for relative movement along the spring and having collapsible means for engaging a pipe and preventing movement of the slide through a pipe in said one direction, a second coil spring surrounding the first spring with the convolutions of the two springs arranged concentrically, said second spring having one end fixed to the first spring and the other end fixed to the slide, said other end and slide positioned on said first spring forward of the point at which said second spring is fixed to the first spring, and stepping cable means including a pulley fixed on the first spring on the side of the slide remote from the second spring and a stepping cable extending over said pulley and secured to the slide for alternately moving the slide against said second spring and permitting the second spring to move the slide and first spring relative to each other.

References Cited in the file of this patent

UNITED STATES PATENTS

273,295 Lytle ---------------- Mar. 6, 1883
673,478 Rodgers ---------------- May 7, 1901
809,880 Woolridge et al. -------- Jan. 9, 1906
914,824 Greenan ---------------- Mar. 9, 1909
1,658,887 Dotzauer ------------- Feb. 14, 1928
2,180,442 Fondevue ------------- Nov. 21, 1939
2,322,508 Crane ---------------- June 22, 1943
2,334,280 Nelson ------------- Nov. 16, 1943
2,767,415 Morris et al. ------- Oct. 23, 1956